

Response to reviewer 2

Thank you for these useful comments, our response to each of the points raised can be found below:

This technical note gives a review of some indices that are used to describe direction and magnitude of hysteretic relationships between discharge and concentration and proposes a new hysteresis index. Hysteretic relationships between concentration (geochemical tracers, nutrients) and discharge or also between storage (i.e. moisture contained within a control volume) and discharge have been used to describe catchment functioning and to compare catchments or different time periods. Observed hysteretic behavior could help to infer flow processes and better understand runoff generation. In that respect, this technical note, although more geared in its current scope towards nutrient and sediment export from (agricultural) catchments, could be interesting for many readers dealing with hillslope and catchment hydrological processes. This technical note is well-written and mostly clear in its explanations and structure

I understand that a technical note has to be brief. Still, I would recommend to provide a short explanation in the introduction of what is meant by hysteresis in this context and to elaborate a bit on the value of a hysteresis index (HI). Why can it be a useful descriptor of catchment functioning? Has the examination of hysteresis patterns advanced process understanding? How can it help to pinpoint release mechanisms for nutrients or sediments beyond a mere comparison of numbers between catchments? What does it mean if a hysteretic loop is clockwise or anti-clockwise in terms of processes? This also refers to the conclusions section where authors state that the new HI could “become a standardized analytical technique to be used by the water quality research community”.

The authors appreciate that some of this background information could be useful to the reader and can help support the value of using a HI, however they are also conscious of the need for brevity in a technical note. Therefore the authors propose that a sentence can be added to the technical note which refers the reader to an additional paper which is currently in press which uses the new hysteresis index as a tool for quantifying hysteresis loops across different parameters and field sites. This paper covers in detail all of the issues you highlight here in your comment and would allow the reader to see how the hysteresis index can be used. We ask for advice from the Editor on the basis this is a technical note paper and such discussion should be limited.

P. 7879, L 3: Please explain TNU

NTU is a standard unit of measurement of turbidity which stands for “Nephelometric Turbidity Units”. This could be added to the manuscript, however we would argue that this abbreviation is widely accepted and commonly used in the hydro-chemical literature. We are happy to clarify this though.

P. 7879, L 19-21: Please make the explanation of the calculation of the adapted HI clearer. What exactly does it mean to calculate HI “at every 25, 10% etc of the discharge” and to calculate for different “sections” (e.g. p. 7884, L 15-19) or use different “increments”. This remained somewhat unclear to me throughout the text.

The original index proposed by Lawler et al. 2006 used the mid-point in discharge to determine the measurement point for the index (50% of the discharge range). Our adapted and new method instead determines multiple locations across the loop at which to measure the strength of the

hysteresis. Therefore we tested the impact of using different numbers of measuring points or increments, including every 25% of the discharge range i.e. 3 equally spaced measurement increments across the loop, 10% of the discharge range (9 increments) etc... If helpful a visual aid could be produced and added to the methodology section to clarify this difference but we believed this was clear in the current text and presentation.

P. 7881, L 25 – p. 7882, L 4: redundant, as it is explained in the figure caption

Agreed, this can be removed as it is repeated in the figure caption.

P. 7883, L 7-14: this description belongs to methods (section 2.3), not results

The description of the new index is covered in the methodology section, however, in the results the details are reiterated in order to clearly explain what the reader is observing in the figure. Therefore the authors would like the sentence to remain.

P. 7884, L 6-7: meaning of sentence unclear

Agreed, this sentence will be amended to read: “This technique is useful when the user’s interest is in the relative characteristics of the loop geometries”.

p. 7884, L 7: “These” means these recommendations?

Yes, should be these recommendations, text can be modified to clarify.